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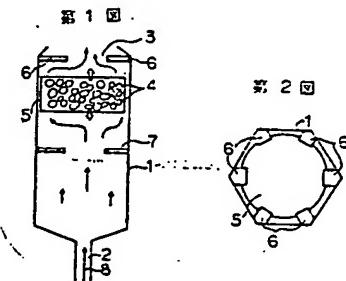
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28.09.84-JP-203864 (25.04.86) G21c-07/22 G21c-09/02  
Automatic reactor stop assembly - includes guide pipe for coolant  
which also contains a neutron absorbing material and partitions  
C86-062998

Assembly comprises a guide pipe which has at the lower end, a coolant incoming port and at the upper end, a coolant outgoing port. Neutron absorbing material which drops downward along with a redn. in flow rate of coolant incoming through the coolant incoming port is contained in the guide pipe together with upper and lower partitions which are adapted to check upward and downward movement of the neutron absorbing material.

USE/ADVANTAGE - Assembly is adapted to automatically detect trouble rapidly. (4pp Dwg. No.1,2/10)

Full Patentees: Nippon Genshiryoku Jigyo; Toshiba KK.

K(5-B6A1)



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## ⑪ 公開特許公報 (A) 昭61-82193

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## ④発明の名称 自動炉停止集合体

②特願 昭59-203864

②出願 昭59(1984)9月28日

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## 明細図

## 1. 発明の名称 自動炉停止集合体

## 2. 特許請求の範囲

(1) 下端に冷却材流入口を、上端に冷却材流出口を備えた中空状の案内管と、この案内管内に収容され前記冷却材流入口から流入する冷却材の流量の低下に伴い下方に落下する中性子吸収体と、前記案内管内に配置され前記中性子吸収体の上方および下方への移動をそれぞれ阻止する上部仕切板および下部仕切板とを備えたことを特徴とする自動炉停止集合体。

(2) 案内管を回転して燃料部を配置してなる特許請求の範囲第1項記載の自動炉停止集合体。

(3) 案内管の下部仕切板の下方に燃料部を配置してなる特許請求の範囲第1項記載の自動炉停止集合体。

## 3. 発明の詳細な説明

## 〔発明の技術分野〕

本発明は高速増殖炉において、炉心事故の拡大を防止するため事故を自動的に迅速に検出し、炉

心をスクラムする自動炉停止集合体に関する。

## 〔発明の技術的背景とその問題点〕

一般に、高速増殖炉では、炉心内に制御棒を挿入することにより炉心内の反応度の制御が行われている。そして原子炉の異常時には、この制御棒が炉心内に急速挿入されスクラムが行なわれる。

しかしながら、このような制御棒を用いてスクラムを行なう場合には、炉心内の異常事態を検出し、この検出信号に基づいて制御棒の操作を行なう必要がある。従って、炉心内の異常を検出する検出器等が故障した場合には、迅速かつ確実なスクラム動作が行なわれないおそれがある。

## 〔発明の目的〕

本発明はかかる従来の事例に対処してなされたもので、事故を自動的にかつ迅速に検出し、原子炉をスクラムすることのできる自動炉停止集合体を提供しようとするものである。

## 〔発明の概要〕

すなわち本発明は、下端に冷却材流入口を、上端に冷却材流出口を備えた中空状の案内管と、こ

原子炉の通常運転時には吸収体カプセル15は、第7図に示すように、軸プランケット11側方に位置している。

一方、炉心流量の低下時には、第8図に示すように、吸収体カプセル15は落下しカプセル密度調整部17が内部プランケット14の側方に位置する状態とされる。これにより炉は自動的に停止し、炉心溶融に至るような大事故を防止することができる。

第9図および第10図は、本発明のさらに他の実施例を示すもので、この実施例では案内管1の下部仕切板7の下方に燃料部9が配置されている。また、吸収体カプセル18は吸収体カプセル18の上下にヘリウムガスを収容するガス収納部19が形成されている。

以上のように構成された自動炉停止集合体では、原子炉の通常運転時には吸収体カプセル18は軸プランケット部11の側方に配置される。

一方、炉心流量が低下すると、吸収体カプセル18は第10図に示すように、その下端を下部仕

止集合体のさらに他の実施例を示す横断面図、第8図は第7図において炉心流量が低下したときの状態を示す横断面図、第9図は本発明の自動炉停止集合体の他の実施例を示す横断面図、第10図は第9図において炉心流量が低下したときの吸収体カプセルの状態を示す横断面図である。

- 1 ………………案内管
- 2 ………………冷却材流入口
- 3 ………………冷却材流出口
- 4 ………………中性子吸収体
- 5 ………………吸収体カプセル
- 6 ………………上部仕切板
- 7 ………………下部仕切板
- 9 ………………燃料部

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切板7に当接し、下方の燃料部9から上方へ漏れる中性子を吸収する。さらに第9図に示す燃料部12からの中性子も吸収する。これにより炉は自動的に停止し、炉心溶融に至るような大事故を防止することができる。

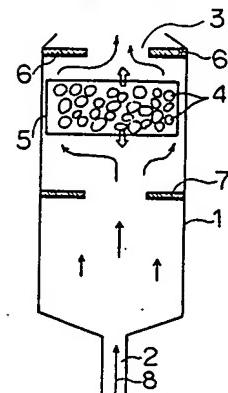
#### [発明の効果]

以上述べたように本発明の自動炉停止集合体によれば、自動炉停止集合体自体に冷却材流量の減少事故を自動的にかつ迅速に検出する機能を持たせたので、どのような事態が生じても炉を自動的に停止することができ、炉心溶融に至るような大事故を確実に防止することができる。

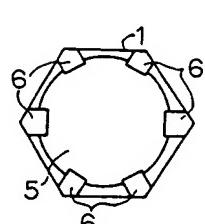
#### 4. 図面の簡単な説明

第1図は本発明の自動炉停止集合体の一実施例を示す横断面図、第2図は第1図の上面図、第3図は炉心流量の減少を示すグラフ、第4図は本発明の自動炉停止集合体の他の実施例を示す横断面図、第5図は第4図の上面図、第6図は第4図において炉心流量が低下したときの吸収体カプセルの状態を示す横断面図、第7図は本発明の自動炉

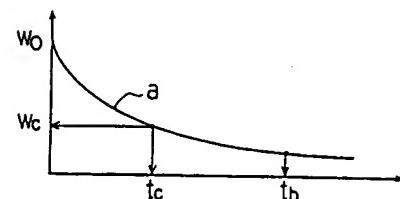
第1図



第2図



第3図



Japanese Published Unexamined (Kokai) Patent Publication No. S61-82193; Publication Date: April 25, 1986; Application No. S59-203864; Application Date: September 28, 1984; Int. Cl.<sup>4</sup>: G21C 9/02 7/22; Inventor(s): Kenichi Suzuki et al.; Applicant: Japan Atomic Power Enterprise Corporation; Japanese Title: Jidouro Teishi Shuugoutai (Atomic Reactor Scramming Assembly)

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Specification

1. Title of Invention

Automatic Reactor Scramming Assembly

2. Claim(s)

- (1) An automatic reactor scrambling assembly, characterized by being comprised of the following components: a coolant flow inlet on the lower end; a hollow guide pipe with a coolant flow outlet on the upper end; a neutron absorbent that falls downward along the decrease of the flow rate of a coolant that flows from the coolant flow inlet, which is stored in the guide pipe; upper and lower partitioning plates that are arranged inside the guide pipe and that individually interrupt the movement of the neutron absorbent upward and downward.
- (2) An automatic reactor scrambling assembly, as disclosed in Claim 1, characterized in that a fuel unit is arranged, surrounding the guide pipe.
- (3) An automatic reactor scrambling assembly, as disclosed in Claim 1, characterized in that the fuel unit is arranged at the lower part of the lower partitioning plate of the guide pipe.

### 3. Detailed Description of the Invention

#### [Field of Industrial Application]

This invention pertains to automatic reactor scrambling assemblies in high-speed breeding reactors, which automatically and quickly detect accidents so as to prevent an expression of core accidents and that scram the cores.

#### [Problem of Prior Art to Be Addressed]

The reactor level inside the cores of high-speed breeding reactors is usually controlled by inserting control rods into the cores. At an abnormal state, the control rods are quickly inserted into the cores of the reactors, and then a scram is performed.

However, when the scram is performed using these control rods, the abnormality inside the cores have to be detected, and the operation of the control rods needs to be performed based on the detection signals. For these reasons, when detectors that detect the abnormality inside the cores fail, a quick and reliable scrambling operation may not be performed.

#### [Purpose of the Invention]

More specifically, the present invention is an automatic reactor scrambling assembly, characterized by being comprised of the following components: a coolant flow inlet on the lower end; a hollow guide pipe with a coolant flow outlet on the upper end; a neutron absorbent that falls downward along the decrease of the flow rate of a coolant that flows from the coolant flow inlet, which is stored in the guide pipe; upper and lower

partitioning plates that are arranged inside the guide pipe and that individually interrupt the movement of the neutron absorbent upward and downward.

[Embodiment]

An embodiment of the invention is described hereinbelow in detail with reference to the drawings.

Fig.1 and Fig.2 illustrate an automatic reactor scrambling assembly as in an embodiment of the invention. In the drawings, reference number 1 refers to a hexagon hollow guide pipe with a coolant flow inlet 2 provided on the lower end and a coolant flow outlet 3 provided on the upper end.

An absorbent capsule 5 that accommodate a large number of neutron absorbents 4 made of boron is stored in guide pipe 1. An upper partitioning plate 6 that interrupts the movement of absorbent capsule 5 upward is arranged at the upper part of absorbent capsule 5. A lower partitioning plate 7 that interrupts the movement of absorbent capsule 5 downward is arranged at the lower part of absorbent capsule 5.

Accordingly, the density of absorbent capsule 5 is predetermined as follow. When the flow rate of a coolant 8 that flows out of coolant flow inlet 2 is higher than a specific value, the upper end of absorbent capsule 5 is brought into contact with upper partitioning plate 6. On the other hand, the flow rate thereof is lower than the specific value. The lower end of absorbent capsule 5 is brought into contact with lower partitioning plate 7.

As indicated in a curvature a, the horizontal and vertical axes indicate time and the flow rate of the coolant, respectively. The density of absorbent capsule 5 is predetermined such that absorbent capsule 5 is brought into contact with upper partitioning plate 6 and

lowers to be in contact with lower partitioning plate 7 between a flow rate  $W_0$  of the coolant at a rating and a minimum flow rate  $W_c$  at a partial charge and between time  $T_c$  and time  $T_b$  when the flow rate of the coolant becomes  $W_c$  or lower, respectively.

With the automatic reactor scrambling assembly as constituted above, as indicated in curvature a, if the flow rate of liquid metallic sodium coolant gradually decreases and if it lowers more than the minimum flow rate during the partial charge, absorbent capsule 5 falls down several to 10 seconds later from time  $T_c$  so as to be brought into contact with lower partitioning plate 7.

By this means, the center of absorbent capsule 5 is located in an almost center of the fuel section of the high-speed breeding reactor. A negative reaction level is charged inside the core. As a result, the reactor automatically stops to prevent serious accidents in advance, which incur the fusion of the core.

More specifically, the automatic reactor scrambling assembly as structured above automatically and quickly performs a scram without having any operations from outside, by reducing the flow rate of the coolant and the flow rate of the core.

Fig.4 and Fig.5 illustrate another embodiment of the invention. In the embodiment, fuel unit 9 is arranged, surrounding guide pipe 1.

In other words, the automatic reactor scrambling assembly as in the embodiment has a form in which guide pipe 1 is inserted in a trumpet-shaped pipe 10. A shaft blanket unit 11 and a fuel unit 12 are formed between guide pipe 1 and trumpet-shaped pipe 10. Additionally, sections 13 to accommodate a helium gas for adjusting the density of the capsule are formed at the upper and lower parts of absorbent capsule 5.

As for the automatic reactor scrambling assembly as structured above, during a normal operation of the reactor, more specifically when the flow rate of the core is at a specific value or higher, the upper end of absorbent capsule 5 is brought into contact with upper partitioning plate 6, and absorbent capsule 5 is located in shaft blanket unit 11.

On the other hand, if the flow rate of the core decreases from the specific value, as shown in Fig.6, absorbent capsule 5 descends so that the center will locate at the center of fuel unit 12. By this means, the reactor will automatically scram and prevent serious accidents so as to incur a core fusion and the like.

Fig.7 and Fig.8 illustrate an embodiment of an automatic reactor scrambling assembly of the invention, which is suitable for a core with an interval blanket unit 14. In the embodiment, a capsule density controlling unit 17 provided with a coolant flow inlet 16 that allows the coolant to flow into the center is arranged in absorbent capsule 15. Absorbents 5 that accommodate neutron absorbents 4 are formed on both sides.

As shown in Fig.7, absorbent capsule 15 is located on the shaft blanket 11 side.

On the other hand, as shown in Fig.8, when the flow rate of the core decreases, absorbent capsule 15 falls. Capsule density controlling unit 17 is then located on the internal blanket 14 side. By these means, the reactor automatically stops so as to prevent serious accidents including the core fusion.

Fig.9 and Fig.10 illustrate another embodiment of the invention. In the embodiment, fuel unit 9 is arranged at the lower part of lower partitioning plate 7 of guide pipe 1. Gas storing units 19 that store a helium gas are formed at the lower and upper parts of absorbent capsule 18.

As for the automatic reactor scrambling assembly as constituted above, absorbent capsule 18 is arranged on the shaft blanket unit 11 during a normal operation of the reactor.

On the other hand, as shown in Fig.10, if the flow rate of the core decreases, the lower end of absorbent capsule 18 is brought into directly contact with lower partitioning plate 7 and then absorbs neutrons that leak from the lower part to the upper part of fuel unit 9. The neutrons from fuel unit 12 as shown in Fig.9 are also absorbed. By these means, the reactor automatically scrams. Subsequently, serious accidents including a core fusion are prevented.

#### [Advantageous Result of the Invention]

As disclosed above, according to the invention, as the function that automatically and quickly detects the decrease in the flow rate if the coolant and accidents is provided to the automatic reactor scrambling assembly, in any situations, the reactor automatically stops. As a consequence, serious accidents leading to a core fusion are reliably prevented.

#### 4. Brief Description of the Invention

Fig.1 is a vertical cross-sectional view illustrating an embodiment of an embodiment of an automatic reactor scrambling assembly of the invention. Fig.2 is a top view of Fig.1. Fig.3 is a graph indicating a decrease in the flow rate of a core. Fig.4 is a vertical cross-sectional view illustrating another embodiment of the automatic reactor scrambling assembly by the invention. Fig.5 is a top view of Fig.4. Fig.6 is a vertical cross-sectional view illustrating an absorbent capsule when the flow rate of the core decreases as

in Fig.4. Fig.7 is a vertical cross-sectional view illustrating another embodiment of the automatic reactor scrambling assembly by the invention. Fig.8 is a vertical cross-sectional view illustrating a state when the flow rate of the core decreases as in Fig.7. Fig.9 is a vertical cross-sectional view illustrating another embodiment of the automatic reactor scrambling assembly by the invention. Fig.10 is a vertical cross-sectional view illustrating an absorbent capsule when the flow rate of the core decreases as in Fig.9.

- 1...Guide pipe
- 2...Coolant flow inlet
- 3...Coolant flow outlet
- 4...Neutron absorbents
- 5...Absorbent capsule
- 6...Upper partitioning plate
- 7...Lower partitioning plate
- 9...Fuel unit

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